6. Claims

1. A defect-inspecting apparatus comprising:

a stage on which an object to be inspected is mounted;

an illumination optical system comprising;

an incident illumination system which incident-illuminates illumination light including UV light or DUV light at a point on a surface of the object to be inspected, which is mounted on the stage, with desired luminous flux from a normal line direction relative to the surface or from a direction in proximity to the normal line; and

a oblique illumination system which oblique-illuminates illumination light including UV light or DUV light at a point on the surface of the object to be inspected with desired luminous flux;

a detection optical system comprising;

a high-angle image formation optical system which condenses first high-angle scattered light traveling at a high angle relative to the surface of the object to be inspected, from among first reflection light generated from the point, which has been incident-illuminated by the incident illumination system of the illumination optical system, and second high-angle scattered light traveling at the high angle, from among second reflection light generated from the point, which has been oblique-illuminated by the oblique illumination system of the illumination optical system, in order to perform

image formation; and

a photoelectric conversion unit which receives the first and the second high-angle scattered light, of which image formation has been performed in the high-angle image formation optical system, to convert the first and the second high-angle scattered light into a first and a second luminance signal; and

a comparison and judgment unit which classifies defects on the object to be inspected into concave defects and convex defects on the basis of a correlation between the first luminance signal and the second luminance signal, which have been converted by the photoelectric conversion unit of the detection optical system.

2. A defect-inspecting apparatus according to Claim 1, wherein:

the incident illumination system of the illumination optical system is configured so that stray light is not generated from the high-angle image information optical system.

3. A defect-inspecting apparatus according to Claim 1, wherein:

the detection optical system further comprises a shielding optical element which shields a specific light image, which is caused by the first reflection light, on a Fourier transformed surface of the first reflection light emitted from the point.

4. A defect-inspecting apparatus according to Claim 1, wherein:

in the comparison and judgment unit, the correlation between the first luminance signal and the second luminance signal is used a ratio between the first luminance signal and the second luminance signal.

5. A defect-inspecting apparatus according to Claim 1, wherein:

the comparison and judgment unit is configured to classify concave defects into scratches and thin film-like foreign materials on the basis of data in response to a defect size calculated by the first luminance signal and the second luminance signal.

6. A defect-inspecting apparatus according to Claim 1, wherein:

the comparison and judgment unit is configured to classify foreign materials, which are convex defects, into a small group and a large group on the basis of data in response to a defect size calculated by the first luminance signal and the second luminance signal.

7. A defect-inspecting apparatus according to Claim 1, wherein:

the comparison and judgment unit is configured to judge that the classified convex defect occurs inside a circuit pattern area, or that the classified convex detect occurs outside the circuit pattern area.

8. A defect-inspecting apparatus according to Claim 1, wherein:

the comparison and judgment unit has a displaying unit which displays information of defects be classified by the comparison and judgment unit.

9. A defect-inspecting apparatus according to Claim 1, wherein:

the comparison and judgment unit has a displaying unit which displays information about a relation of the first luminance signal to be classified the defects.

10. A defect-inspecting apparatus according to Claim 1, wherein:

the comparison and judgment unit has a displaying unit for displaying information about a relation of the second luminance signal to discriminate a defect.

11. A defect-inspecting apparatus according to Claim 1, wherein:

the comparison and judgment unit has a displaying unit for plotting a relation between the first luminance signal and the second luminance signal, which have been converted by the photoelectric conversion means of the detection optical system, on a correlation diagram, where a horizontal axis and a vertical axis are expressed by logarithm values, to display the relation.

12. A defect-inspecting apparatus according to Claim 1, wherein:

in the illumination optical system, a point incident-illuminated by the incident illumination system and a point oblique-illuminated by the oblique illumination system, which are on the surface of the object to be inspected, are configured to be different from each other in a visual field of the detection optical system.

13. A defect-inspecting apparatus comprising:

a stage on which an object to be inspected is mounted;

an illumination optical system comprising;

an incident illumination system that incident-illuminates illumination light including UV light or DUV light at a point on a surface of the object to be inspected, which is mounted on the stage, with desired luminous flux from a normal line direction relative to the surface or from a direction in proximity to the normal line; and

a oblique illumination system that oblique-illuminates illumination light including UV light or DUV light, which has a wavelength different from that of said incident-illuminated illumination light, at a point on the surface of the object to be inspected with desired luminous flux;

a detection optical system comprising;

a condensing optical system which condenses first high-angle scattered light traveling at a high angle relative to the surface of the object to be inspected, from among first reflection light generated from the point, which has been incident-illuminated by the incident illumination system of

the illumination optical system, and second high-angle scattered light traveling at the high angle, from among second reflection light generated from the point, which has been oblique-illuminated by the oblique illumination system of the illumination optical system; and

a wavelength separation optical system which wavelength-separates the first high-angle scattered light and the second high-angle scattered light, which have been condensed by the condensing optical system;

an image formation optical system which performs image formation of each of the first high-angle scattered light and the second high-angle scattered light, which have been separated by the wavelength separation optical system; and

a first and a second photoelectric conversion unit which receives each of the first high-angle scattered light and the second high-angle scattered light, for which image formation has been performed by the image formation optical system, to convert the first high-angle scattered light and the second high-angle scattered light into a first luminance signal and a second luminance signal respectively; and

a comparison and judgment unit which discriminates a defect on the object to be inspected on the basis of a relation between the first luminance signal converted by the first photoelectric conversion means and the second luminance signal converted by the second photoelectric conversion means in the detection optical system.

14. A defect-inspecting apparatus according to Claim 13, wherein:

the incident illumination system of the illumination optical system is configured so that stray light is not generated from the high-angle condensation optical system.

15. A defect-inspecting apparatus according to Claim 13, wherein:

the detection optical system further comprises a shielding element which shields a specific light image, which is caused by the first reflection light, on a Fourier transformed surface of the first reflection light emitted from the point.

16. A defect-inspecting apparatus according to Claim 13, wherein:

in the comparison and judgment unit, ratios are used as the correlation.

17. A defect-inspecting apparatus according to Claim 13, wherein:

the comparison and judgment unit is configured to classify concave defects into scratches and thin film-like foreign materials on the basis of data in response to a defect size calculated by the first luminance signal and the second luminance signal.

18. A defect-inspecting apparatus according to Claim 13, wherein:

the comparison and judgment unit is configured to

classify particulate foreign materials, which are convex defects, into a small group and a large group on the basis of data in response to a defect size calculated by the first luminance signal and the second luminance signal.

19. A defect-inspecting apparatus according to Claim 13, wherein:

the comparison and judgment unit is configured to judge that the classified convex defect occurs inside a circuit pattern area, or that the classified convex detect occurs outside the circuit pattern area.

20. A defect-inspecting apparatus according to Claim 13, wherein:

the comparison and judgment unit has an displaying means for displaying information of a discriminated defect.

21. A defect-inspecting apparatus according to Claim 13, wherein:

the comparison and judgment unit has a displaying means for displaying information about a relation of the first luminance signal to discriminate a defect.

22. A defect-inspecting apparatus according to Claim 13, wherein:

the comparison and judgment unit has a displaying means for displaying information about a relation of the second luminance signal to discriminate a defect.

23. A defect-inspecting apparatus according to Claim 13, wherein:

the comparison and judgment unit has a displaying means for plotting a relation between the first luminance signal and the second luminance signal, which have been converted by the photoelectric conversion means of the detection optical system, on a correlation diagram, where a horizontal axis and a vertical axis are expressed by logarithm values, to display the relation.

24. A defect-inspecting method comprising the steps of:

incident-illuminating and oblique-illuminating illumination light including UV light or DUV light on a shallow scratch and a foreign material, which are made on a surface of a polished or a ground film, with substantially the same luminous flux;

receiving scattered light caused by the shallow scratch and the foreign material by a detector, said scattered light being generated by the incident illumination and the oblique illumination, to convert the scattered light into luminance signals in response to each intensity of the scattered light; and

discriminating between the shallow scratch and the particulate foreign material on the basis of a correlation of the converted luminance signals.

25. A defect-inspecting method comprising the steps of:

incident-illuminating and oblique-illuminating illumination light including UV light or DUV light on a flat thin film-like foreign material and a foreign material, which

are made on a surface of a polished, washed, or a sputtered film, with substantially the same luminous flux;

receiving scattered light caused by the thin film-like foreign material and the foreign material by a detector, said scattered light being generated by the incident illumination and the oblique illumination, to convert the scattered light into luminance signals in response to each intensity of the scattered light; and

discriminating between the thin film-like foreign material and the particulate foreign material on the basis of a correlation of the converted luminance signals.

26. A defect-inspecting method comprising the steps of:

an illumination step for

incident-illuminating illumination light including UV light or DUV light at a point on a surface of an object to be inspected, which is mounted on a stage, with desired luminous flux from a normal line direction relative to the surface or from a direction in proximity to the normal line, using an incident-illuminating system; and

oblique-illuminating illumination light including UV light or DUV light at a point on the surface of the object to be inspected with desired luminous flux, using a oblique-illuminating system;

a detection step for

condensing first high-angle scattered light traveling at a high angle relative to the surface of the object to be

inspected, from among first reflection light generated from the point, which has been incident-illuminated by the illumination step, and second high-angle scattered light traveling at the high angle, from among second reflection light generated from the point, which has been oblique-illuminated by the illumination step, using a high-angle image formation optical system in order to perform image formation; and

receiving the first high-angle scattered light and the second high-angle scattered light, for which image formation have been performed, using a photoelectric conversion means to convert the first high-angle scattered light and the second high-angle scattered light into a first and a second luminance signal; and

a comparison and judgment step for classifying defects on the object to be inspected into concave defects and convex defects on the basis of a correlation between the first luminance signal and the second luminance signal, which have been converted by the detection step.

27. A defect-inspecting method comprising the steps of:

an illumination step for

incident-illuminating illumination light including UV light or DUV light at a point on a surface of an object to be inspected, which is mounted on a stage, with desired luminous flux from a normal line direction relative to the surface or from a direction in proximity to the normal line, using an

incident-illuminating system; and

oblique-illuminating illumination light including UV light or DUV light, which has a wavelength different from that of said incident-illuminated illumination light, at a point on the surface of the object to be inspected with desired luminous flux using a oblique illumination system;

a detection step for

condensing first high-angle scattered light traveling at a high angle relative to the surface of the object to be inspected, from among first reflection light generated from the point, which has been incident-illuminated by the illumination step, and second high-angle scattered light traveling at the high angle, from among second reflection light generated from the point, which has been oblique-illuminated by the illumination step, using a condensing optical system;

wavelength-separating the first high-angle scattered light and the second high-angle scattered light, which have been condensed, using a wavelength separation optical system;

performing image formation for each of the first high-angle scattered light and the second high-angle scattered light, which have been wavelength-separated, using an image formation optical system; and

receiving each of the first high-angle scattered light and the second high-angle scattered light, for which image formation has been performed, using a first and a second

photoelectric conversion means to convert the first high-angle scattered light and the second high-angle scattered light into a first luminance signal and a second luminance signal respectively; and

a comparison and judgment step for discriminating a defect on the object to be inspected on the basis of a correlation between the first luminance signal converted by the detection step and the second luminance signal converted by the second photoelectric conversion means.

28. A method for producing a semiconductor device comprising the steps of:

a fabrication process for polishing or grinding an object surface of a semiconductor device;

a defect inspection process for

incident-illuminating and oblique-illuminating illumination light including UV light or DUV light on a shallow scratch and a foreign material, which have been made on the object surface polished or ground by the fabrication process, with substantially the same luminous flux;

receiving scattered light caused by a shallow scratch and a foreign material by a detector, said scattered light being generated by the incident illumination and the oblique illumination, to convert the scattered light into luminance signals in response to each intensity of the scattered light; and

discriminating between the shallow scratch and the

particulate foreign material on the basis of a correlation of the converted luminance signals; and

a feedback process for supplying the fabrication process with information of the shallow scratch and the particulate foreign material, which have been discriminated in the defect inspection process, as feedback.

29. A method for producing a semiconductor device comprising the steps of:

a fabrication process for polishing, washing, or sputtering an object surface of a semiconductor device;

a defect inspection process for

incident-illuminating and oblique-illuminating illumination light including UV light or DUV light on a flat thin film-like foreign material and a foreign material, which have been made on the object surface polished, washed, or sputtered by the fabrication process, with substantially the same luminous flux;

receiving scattered light caused by the thin film-like foreign material and the foreign material by a detector, said scattered light being generated by the incident illumination and the oblique illumination, to convert the scattered light into luminance signals in response to each intensity of the scattered light; and

discriminating between the thin film-like foreign material and the particulate foreign material on the basis of a correlation of the converted luminance signals; and

a feedback process for supplying the fabrication process with information of the thin film-like foreign material and the particulate foreign material, which have been discriminated in the defect inspection process, as feedback.